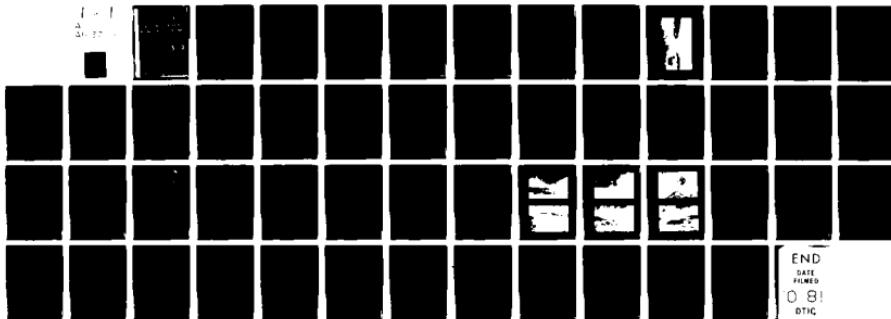


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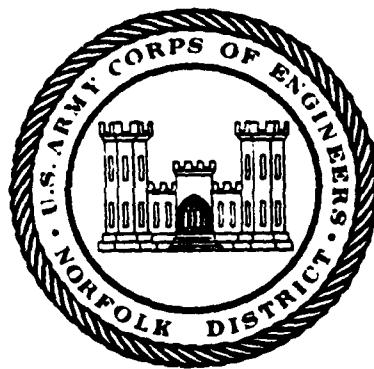
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Name of Dam: Beatties Millpond Dam  
Location: Hanover County, State of Virginia  
Inventory Number: VA 08535

**LEVEL**

# **PHASE I INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM**

**ADA103720**



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**PREPARED FOR  
NORFOLK DISTRICT CORPS OF ENGINEERS  
803 FRONT STREET  
NORFOLK, VIRGINIA 23510**

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**PREPARED BY  
MICHAEL BAKER, JR., INC.  
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**April 1981**

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| 4. TITLE (and Subtitle)  | 5. TYPE OF REPORT & PERIOD COVERED                          |                               |
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20. Abstract

Pursuant to Public Law 92-367, Phase I Inspection Reports are prepared under guidance contained in the recommended guidelines for safety inspection of dams, published by the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I Inspection is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general conditions of the dam is based upon available data and visual inspection. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

Based upon the field conditions at the time of the field inspection and all available engineering data, the Phase I report addresses the hydraulic, hydrologic, geologic, geotechnic, and structural aspects of the dam. The engineering techniques employed give a reasonably accurate assessment of the conditions of the dam. It should be realized that certain engineering aspects cannot be fully analyzed during a Phase I inspection. Assessment and remedial measures in the report include the requirements of additional indepth study when necessary.

Phase I reports include project information of the dam appurtenances, all existing engineering data, operational procedures, hydraulic/hydrologic data of the watershed, dam stability, visual inspection report and an assessment including required remedial measures.

## PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of the Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the design flood should not be interpreted as necessarily posing a highly inadequate condition. The design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM

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NAME OF DAM: BEATTIES MILLPOND DAM

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Beatties Millpond Dam  
State: Commonwealth of Virginia  
County: Hanover  
USGS 7.5 Minute Quadrangles: Seven Pines, VA and Quinton, VA  
Stream: Sandy Valley Creek  
Date of Inspection: 15 January 1981

BRIEF ASSESSMENT OF DAM

Beatties Millpond Dam is an earthfill embankment approximately 13.9 feet high<sup>1</sup> and 365 feet long with a 32 foot wide broad-crested concrete weir spillway located at the left abutment.<sup>2</sup> The dam, located about 2.3 miles northeast of Old Cold Harbor, Virginia, is used for recreation. The dam is owned by Mrs. John Beattie, RT 4 Box 404, Mechanicsville, Virginia 23111. Beatties Millpond Dam is a "small" size - "significant" hazard structure as defined by the Recommended Guidelines for Safety Inspection of Dams. The dam and appurtenant structures were in good overall condition at the time of inspection. Maintenance of the dam is considered to be inadequate. A stability check of the dam is not required.

Using the Corps of Engineers' screening criteria for initial review of spillway adequacy, the 100-year flood was selected as the spillway design flood (SDF). The spillway is capable of passing up to 40 percent of the SDF or 8 percent of the PMF without overtopping the dam. A dam failure from overtopping would not significantly increase the hazard to loss of life downstream from the dam over that which would exist just before overtopping failure. However, overtopping flows from the SDF are considered detrimental to the earth embankment. Therefore, the spillway is adjudged as inadequate but not seriously inadequate.

The visual inspection and office analyses indicate deficiencies requiring remedial treatment.

<sup>1</sup>Measured from the streambed at the downstream toe to the embankment crest.

<sup>2</sup>Facing downstream.

NAME OF DAM: BEATTIES MILLPOND DAM

A formal warning system and emergency action plan should be developed and put into effect as soon as possible.

Regular inspections should be made of the dam and appurtenant structures. A thorough check list should be compiled for use by the owner's representative as a guide for the inspections. Maintenance items should be completed annually.

If seeps develop and flows increase or if turbidity is noted, a qualified geotechnical engineering firm should be retained to perform a stability check on the dam.

The following measures should be undertaken as part of a regularly scheduled inspection and maintenance program:

- 1) Cut off all trees and brush growing on the embankment at ground level. All trees with a trunk diameter greater than 3 inches should have their root systems removed. The resultant holes should be backfilled, compacted, and seeded.
- 2) Establish a good grass cover over the entire embankment.
- 3) Place riprap on the upstream embankment to minimize erosion due to wave action.
- 4) Repair the eroded and undercut areas beneath the downstream ends of the training and wing walls of the principal spillway. The eroded and slumped areas should be backfilled, compacted and seeded.
- 5) After repairs are made to the principal spillway, examine the area at regular intervals for renewed signs of seepage.
- 6) Rebuild the concrete step in the principal spillway.
- 7) Place riprap at the pool of the spillway to prevent scouring of the pool and erosion of the areas beneath the concrete step and the wing and training walls.
- 8) Divert the flow from the natural spring in the hillside downstream from the right abutment away from the toe of the dam.
- 9) Remove the tree obstructing the approach area of the principal spillway.

NAME OF DAM: BEATTIES MILLPOND DAM

- 10) Remove the trees obstructing the lower end of the discharge channel.
- 11) Install a staff gage to monitor reservoir levels above normal pool.

MICHAEL BAKER, JR., INC. SUBMITTED:

  
Michael Baker, III, P.E.  
Chairman of the Board and  
Chief Executive Officer

Original signed by  
**JAMES A. WALSH**

James A. Walsh, P.E.  
Chief, Design Branch

RECOMMENDED:

Original signed by  
**JACK G. STARR**

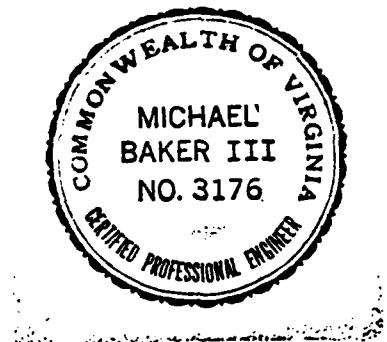
Jack G. Starr, P.E.  
Chief, Engineering

APPROVED:

Original signed by:  
**Douglas L. Haller**

Douglas L. Haller  
Colonel, Corps of Engineers  
District Engineer

Date: APR 21 1981



NAME OF DAM: BEATTIES MILLPOND DAM

**OVERALL VIEW OF DAM**



PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM  
NAME OF DAM: BEATTIES MILLPOND DAM ID# VA 08535

SECTION 1 - PROJECT INFORMATION

1.1 General

- 1.1.1 Authority: Public Law 92-367, 8 August 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of safety inspections of dams throughout the United States. The Norfolk District has been assigned the responsibility of supervising the inspection of dams in the Commonwealth of Virginia.
- 1.1.2 Purpose of Inspection: The purpose is to conduct a Phase I inspection according to the Recommended Guidelines for Safety Inspection of Dams (Reference 12, Appendix IV). The main responsibility is to expeditiously identify those dams which may be a potential hazard to human life or property.

1.2 Description of Project

- 1.2.1 Description of Dam and Appurtenances: Beatties Millpond Dam is an earthfill embankment approximately 13.9 feet high<sup>1</sup> and 365 feet long. The crest of the dam is about 16 feet wide and the minimum elevation is at 1002.7 feet Temporary Bench Mark (T.B.M.).<sup>2</sup> The upstream embankment slope is approximately 3.2H:1V (Horizontal to Vertical) and the slope of the downstream embankment ranges from 3.2H:1V to 4.5H:1V. There is no information available on any possible zoning of the embankment. No evidence of an internal drainage system or slope protection for the dam was found.

<sup>1</sup>Measured from the streambed at the downstream toe of the dam to the embankment crest.

<sup>2</sup>All elevations are referenced to a Temporary Bench Mark located on the left side of the spillway crest. The assumed elevation is 1000.0 feet.

NAME OF DAM: BEATTIES MILLPOND DAM

The principal spillway is a cast-in-place, broad-crested concrete weir located at the left abutment.<sup>3</sup> This spillway is 32 feet long (measured perpendicular to the flow) and has a minimum crest elevation of 999.8 feet T.B.M. Five equally spaced concrete piers are located across the upstream end of the spillway. The concrete weir is 18 inches wide (measured in the direction of flow). After passing over the weir, water flows down an 11.5 foot long concrete apron which has a downstream slope of 17 percent. The water then drops three feet to a concrete step that runs the length of the spillway and is between 2 and 4 feet wide. From this step, the water drops about 8 feet to a pool at the base of the dam.

On the right abutment, an old channel was observed which at one time reportedly contained the raceway for the original mill at the dam. This channel has been filled from the upstream crest to the downstream toe of the dam.

The reservoir has a 3.93 square mile drainage area south and west of the dam. Sandy Valley Creek drains the watershed from the west and a small unnamed tributary drains from the south. The watershed area is moderately sloping and is about 65 percent forested. The remaining 35 percent is primarily farmland.

There are no facilities for draining the reservoir.

- 1.2.2      Location: Beatties Millpond Dam is located in Hanover County, Virginia, approximately 2.3 miles northeast of Old Cold Harbor on Sandy Valley Creek, a tributary to the Matapequin Creek. A Location Plan is included with this report in Appendix I.
- 1.2.3      Size Classification: Beatties Millpond Dam is 13.9 feet high and the reservoir storage at the crest of the dam (elevation 1002.7 feet) is 107 acre-feet. Therefore, the dam is in

<sup>3</sup>Facing downstream.

NAME OF DAM: BEATTIES MILLPOND DAM

the "small" size category as defined by the Recommended Guidelines for Safety Inspection of Dams.

- 1.2.4 Hazard Classification: A feed mill, which is operated on a part-time basis, is located about 150 feet downstream of the dam below the right side of the embankment. Virginia Route 634 is located about 300 feet downstream of the dam. The road embankment is about one foot higher than the crest of the spillway. The access road to the feed mill is located about halfway between the dam and VA Route 634. Loss of human life in the event of dam failure is not considered highly probable. However, economic losses due to damage to the feed mill, the access road, and VA Route 634 are considered likely in the event of dam failure. Beatties Millpond Dam is therefore considered in the "significant" hazard category as defined by the Recommended Guidelines for Safety Inspection of Dams. The hazard classification used to categorize dams is a function of location only and is not related to stability or probability of failure.
- 1.2.5 Ownership: The dam is owned by Mrs. John (Frances) Beattie, RT 4 Box 404, Mechanicsville, Virginia 23111.
- 1.2.6 Purpose: The dam is used for recreational purposes.
- 1.2.7 Design and Construction History: The owner indicated that a number of dams have existed at this site for 200 years. The present dam is believed to have been built around 1921. According to the owner, the dam was breached and partially rebuilt in 1959. No other information on design and construction history was available for use in this report.
- 1.2.8 Normal Operating Procedures: The reservoir level is maintained automatically by the crest of the principal spillway (elevation 999.8 feet T.B.M.). No formal operating procedures are followed for this structure.

NAME OF DAM: BEATTIES MILLPOND DAM

### **1.3 Pertinent Data**

- 1.3.1 Drainage Area: The drainage area tributary to the dam is 3.93 square miles.
- 1.3.2 Discharge at Dam Site: The maximum discharge from the reservoir is unknown. However, the dam is reported to have been overtopped in 1939, 1959 and 1971. With the pool level at the top of dam, the spillway is capable of passing 480 c.f.s.
- 1.3.3 Dam and Reservoir Data: Pertinent data on the dam and reservoir are provided in the following table:

**TABLE 1.1 DAM AND RESERVOIR DATA**

| Item                | Elevation<br>(feet T.B.M.) | Area<br>(acres) | Reservoir<br>Capacity |                       |                  |
|---------------------|----------------------------|-----------------|-----------------------|-----------------------|------------------|
|                     |                            |                 | Acre-<br>feet         | Watershed<br>(inches) | Length<br>(feet) |
| Top of dam          | 1002.7                     | 32.6            | 107                   | 0.5                   | 5800             |
| Spillway crest      | 999.8                      | 11.9            | 45                    | 0.2                   | 3700             |
| Streambed at<br>toe | 988.8                      | -               | -                     | -                     | -                |

NAME OF DAM: BEATTIES MILLPOND DAM

## SECTION 2 - ENGINEERING DATA

- 2.1 Design: Design plans, specifications, and boring logs were not available for use in preparing this report. No stability analyses or hydrologic and hydraulic data were available for review.
- 2.2 Construction: Construction records, as-built plans, and inspection logs were not available for review.
- 2.3 Evaluation: No design or construction records were available for use in assessing the condition of the dam. All evaluations and assessments in this report were based upon field observations, conversations with the owner and her representatives, and office analyses.

NAME OF DAM: BEATTIES MILLPOND DAM

## SECTION 3 - VISUAL INSPECTION

### 3.1 Findings

#### 3.1.1

General: The field inspection was conducted on 15 January 1981. At the time of inspection, the pool elevation was at 1000.1 feet T.B.M., and the tailwater elevation was 989.3 feet T.B.M. The weather was cloudy with occasional snow flurries and a temperature around 30 degrees Fahrenheit. The ground surface of the embankment and abutments was generally frozen and a light dusting of snow was present. The dam and appurtenant structures were found to be in fair overall condition at the time of inspection. Deficiencies found during the inspection will require remedial treatment. The following are brief summaries of these deficiencies. A Field Sketch of conditions observed during the inspection is presented as Plate I in Appendix I. The complete visual inspection check list is included as Appendix III. No record of any previous inspections was found.

#### 3.1.2

Dam: The embankment was found to be in fair overall condition. The upstream embankment has been moderately eroded due to wave action. There was no riprap observed on the upstream embankment and the vegetative cover in that area consisted of weeds and small brush (Photo 2). A large part of the downstream embankment was vegetated with a dense growth of small trees and brush (Photo 1). A small slough was observed near the right center of the dam, but it is apparently stabilized by vegetation. A concrete wall and an old channel were observed at the right abutment (Photo 6). This channel is backfilled downstream from the crest of the dam. It appears to have been the old raceway for the mill.

Above the junction of the embankment and the right abutment, the wooded hillside has been slightly eroded in a few areas.

Seepage from a natural spring in the hillside downstream from the right abutment flows along the toe of the dam from right to left.

NAME OF DAM: BEATTIES MILLPOND DAM

No evidence of an internal drainage system was found during the inspection.

- 3.1.3      Appurtenant Structures: The principal spillway (as described in Section 1.2.1) is a cast-in-place, broad-crested concrete weir. The spillway is 32 feet wide with 3.5 foot high concrete training walls. There was some sediment observed in the approach area to the spillway. A tree trunk partially obstructs the right side of the spillway approach area. Five concrete piers are equally spaced across the spillway near the crest. There is some spalling at the base of all the piers. The concrete is completely deteriorated at the base of two of the piers. These two piers have fallen over and are being held in place by steel rebars. There was some minor spalling and small cracks observed on the concrete spillway. Water goes over the 18 inch long broad-crested weir and flows down an 11.5 foot long concrete apron which has a downstream slope of 17 percent. The water then drops 3 feet to a badly deteriorated concrete step that extends across the length of the spillway and is between 2 and 4 feet long. The area beneath the concrete step and the downstream ends of the training walls and wing walls has been undercut and eroded (Photo 4). Steadily flowing seeps are coming from behind both walls. Seepage from the right side has apparently created a 3 foot deep slump hole behind the right training wall (Photo 5). After flowing over the concrete step, the water takes a near vertical drop of about 8 feet over a hard clay surface to a scoured pool at the base of the dam. From the pool, water flows into a 20 foot wide discharge channel. The left bank of the channel is an eroded and very steep 70 foot high hillside. Trees have fallen off this bank and are partially obstructing the lower end of the discharge channel.

No emergency spillway or facilities for draining the reservoir were observed during the inspection.

- 3.1.4      Reservoir Area: The slopes that surround the reservoir are moderately sloping and wooded.

NAME OF DAM: BEATTIES MILLPOND DAM

A few residences and cabins are located along the banks of the reservoir about 15 to 20 feet above the normal pool elevation. No indication of any significant erosion was noted. The extent of sedimentation was not directly observed, but it does not appear to be significant. Soundings taken at the time of inspection show the depth to be 11.4 feet at a spot approximately 50 feet offshore from the approximate center of the embankment.

3.1.5

Downstream Channel: The downstream channel beyond the immediate discharge area is a natural channel with a generally flat gradient and moderately sloping sides. The channel flows through four 42 inch diameter corrugated metal culverts at the access road to the mill about 150 feet below the dam, and three 5 foot diameter corrugated metal culverts under VA Route 634 about 300 feet below the dam. Below VA Route 634 the banks of the downstream channel contain thick brush and trees.

3.1.6

Instrumentation: There was no instrumentation at the dam site at the time of inspection.

3.2

Evaluation: In general, the dam and appurtenant structures were in good condition. All trees on the downstream embankment should be cut off at ground level. All trees with a trunk diameter greater than 3 inches should have their root systems removed. The resultant holes should be backfilled, compacted and seeded. A good grass cover should be established over the entire embankment. Riprap should be placed on the upstream embankment to minimize erosion from wave action. The small slough near the center of the dam is apparently stabilized by vegetation and is not considered serious.

Repairs should be made at the undercut and eroded areas beneath the downstream ends of the training and wing walls. The eroded and slumped areas behind the walls should be backfilled, compacted, and seeded. The concrete step in the principal spillway should be rebuilt. Riprap should be placed at the base of the spillway to prevent scouring of the pool and undercutting and erosion of areas beneath the spillway and spillway walls. After making these repairs, the area should be monitored for renewed signs of seepage.

NAME OF DAM: BEATTIES MILLPOND DAM

Seepage from a natural spring in the hillside downstream from the right abutment should be diverted away from the toe of the dam.

The tree partially obstructing the approach area to the principal spillway and the trees obstructing the lower end of the discharge channel should be removed.

A staff gage should be installed to monitor reservoir levels above normal pool.

NAME OF DAM: BEATTIES MILLPOND DAM

#### SECTION 4 - OPERATIONAL PROCEDURES

- 4.1 Procedures: The operation of the dam is an automatic function controlled by the crest of the spillway at elevation 999.8 feet T.B.M.
- 4.2 Maintenance of Dam: Maintenance of the dam is the responsibility of the owner. An inspection and maintenance schedule has not been instituted.
- 4.3 Maintenance of Operating Facilities: There are no operating facilities on the dam.
- 4.4 Warning System: At the time of inspection, there was no warning system or emergency action plan in operation.
- 4.5 Evaluation: Maintenance of the dam in the past has been inadequate. Regular inspections of the dam and appurtenant structures should be made and documented. A thorough check list should be compiled for use by the owner's representative as a guide for the inspections. Maintenance items should be corrected annually. In addition, a formal warning system and emergency action plan should be developed and put into operation as soon as possible.

NAME OF DAM: BEATTIES MILLPOND DAM

## SECTION 5 - HYDRAULIC/HYDROLOGIC DATA

- 5.1 Design: No design data were available for use in preparing this report.
- 5.2 Hydrologic Information: No rainfall, stream gage or reservoir stage records are maintained for this dam.
- 5.3 Flood Experience: According to the owner, the dam was overtopped by flooding in 1929, 1959 and 1971.
- 5.4 Flood Potential: The Probable Maximum Flood (PMF), 1/2 Probable Maximum Flood (1/2 PMF), and 100-year flood were developed and routed through the reservoir by use of the HEC-1 DB computer program (Reference 9, Appendix IV) and appropriate unit hydrograph, precipitation and storage-outflow data. Clark's T<sub>c</sub> and R coefficients for the local drainage areas were estimated from basin characteristics. The rainfall applied to the unit hydrograph was taken from publications by the U.S. Weather Bureau and the National Oceanic and Atmospheric Administration (References 16 and 17, Appendix IV). Rainfall losses for the PMF and 1/2 PMF were estimated at an initial loss of 1.0 inch and a constant loss rate of 0.05 inch per hour thereafter. Rainfall losses for the 100-year flood were estimated at an initial loss of 1.5 inches and a constant loss rate of 0.15 inch per hour thereafter.
- 5.5 Reservoir Regulation: Pertinent dam and reservoir data are provided in Table 1.1, Paragraph 1.3.3. Regulation of flow from the reservoir is automatic. Normal flows are maintained by the crest of the spillway, which is at elevation 999.8 feet T.B.M.
- The outlet discharge capacity was computed by hand, reservoir area was planimetered from the Seven Pines Virginia and Quinton, Virginia, 7.5 minute USGS quadrangles, and storage capacity curves were computed to elevations above the crest of the dam. All flood routings were begun with the reservoir at normal pool.
- 5.6 Overtopping Potential: The probable rise of the reservoir and other pertinent information on reservoir performance are shown in the following table:

NAME OF DAM: BEATTIES MILLPOND DAM

**TABLE 5.1 RESERVOIR PERFORMANCE**

| Item  | Normal <sup>1</sup> | Hydrographs       |            |                  |
|---|---------------------|-------------------|------------|------------------|
|   |                     | 100-Year<br>flood | 1/2<br>PMF | PMF <sup>2</sup> |
| <b>Peak flow, c.f.s.</b>  |                     |                   |            |                  |
| Inflow  | 6.9                 | 2,754             | 7,685      | 15,369           |
| Outflow   | 6.9                 | 2,731             | 7,642      | 15,287           |
| Peak elev., ft. T.B.M.  | 1000.1              | 1004.9            | 1006.7     | 1008.6           |
| <b>Non-overflow section<sup>3</sup></b><br><b>(elev. 1002.7 ft. T.B.M.)</b> |                     |                   |            |                  |
| Depth of flow, ft.  | -                   | 2.2               | 4.0        | 5.9              |
| Average velocity, f.p.s.  | -                   | 6.9               | 9.3        | 11.3             |
| Total duration of over-<br>topping, hrs.                                    | -                   | 6.8               | 20.8       | 28.0             |
| Tailwater elev., ft. T.B.M.   | 989.3               | -                 | -          | -                |

<sup>1</sup>Conditions at time of inspection.

<sup>2</sup>The PMF is an estimate of flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in a region.

<sup>3</sup>Velocity estimates were based on critical depth at control section.

**5.7 Reservoir Emptying Potential:** There are no facilities for draining the reservoir.

**5.8 Evaluation:** Beatties Millpond Dam is a "small" size - "significant" hazard dam requiring evaluation for a spillway design flood (SDF) in the range between the 100-year flood and the 1/2 PMF. Due to the risk involved, the 100-year flood was selected as the SDF. The SDF was routed through the reservoir and found to overtop the dam by a maximum depth of 2.2 feet and an average critical velocity of 6.9 feet per second (f.p.s.). Total duration of dam overtopping would be 6.8 hours. The spillway is capable of passing up to 8 percent of the Probable Maximum Flood (PMF) or 40 percent of the SDF without overtopping the crest of the dam.

Conclusions pertain to present day conditions and the effect of future development on the hydrology has not been considered.

NAME OF DAM: BEATTIES MILLPOND DAM

## SECTION 6 - DAM STABILITY

6.1 Foundation and Abutments: The dam is located in the Atlantic Coastal Plain geologic region in an area underlain by the St. Mary's formation of Tertiary age. The St. Mary's formation generally consists of unconsolidated sands and clays. Soils exposed downstream of the left abutment were observed to consist of yellow, gray, and brown sandy clay or clayey sand of low plasticity. Similar soils were observed in the discharge channel below the spillway of the dam. No previous information describing local subsurface conditions was available for the visual inspection or subsequent analyses. It is not known how the dam was keyed into the foundation and abutments.

### 6.2 Embankment

6.2.1 Materials: Information describing the nature of the embankment materials within the dam was not available for this inspection. According to the owner, who had breached the dam in 1959, the embankment materials are homogeneous. During the visual inspection, the outer embankment materials were observed to consist of brown sandy clay of low plasticity.

6.2.2 Stability: Design plans or the results of a previous stability analysis were not available for use during this evaluation. Based on the owner's observations of the dam structure, the embankment is assumed to be a homogeneous type. The dam is 13.9 feet high with a crest width of about 14 to 18 feet. The upstream embankment was observed to slope at 3.2H:1V, while the downstream embankment was observed to slope from 3.2H:1V to 4.5H:1V. No facilities exist for draining the reservoir in the event of an emergency, and the embankment is not subject to rapid drawdown.

According to guidelines outlined in Design of Small Dams by the U.S. Department of Interior, Bureau of Reclamation, the upstream slope of a small homogeneous dam constructed of slightly plastic fine grained soils (CL,ML) with a

NAME OF DAM: BEATTIES MILLPOND DAM

stable foundation should be 3.OH:1V, if not subject to rapid drawdown. The corresponding downstream slope should be 2.5H:1V. A crest width of 12.8 feet is recommended, considering the height of the dam. Based on these guidelines, both the slopes and the crest width are considered adequate.

No major signs of instability were observed during the visual inspection. However, seepage was observed flowing from the abutment and embankment behind the training walls and wing walls of the spillway. This seepage has caused erosion of the embankment behind the right training wall with consequent settlement of the crest in a small area directly adjacent to the wall. In addition, the downstream ends of both training walls are exposed and undermined, due to the seepage. Elsewhere on the embankment, minor erosion was observed on the upstream face slightly above pool elevation at the time of inspection. Other than at the spillway, no seepage was noted at any point on or below the embankment. Brush and small trees were observed growing on parts of the embankment slopes.

#### 6.2.3

Seismic Stability: The dam is located in Seismic Zone 1, which presents no hazard from earthquakes, according to the Recommended Guidelines for Safety Inspection of Dams by the Department of the Army, Office of the Chief of Engineers. This determination is contingent on the requirements that static stability conditions are satisfactory and conventional safety margins exist.

#### 6.3

Evaluation: The results of a previous stability analysis were not available for review as part of this evaluation. Both the upstream and downstream slopes are adequate when compared to the Bureau of Reclamation guidelines. The crest width is about one to five feet wider than recommended. The embankment appears to be in fair overall condition. The dam requires no further check of stability at this time. However, the problems discussed above, including the seepage at the spillway and vegetation on the embankment, require further attention in order to prevent serious problems in the future. Remedial measures are discussed in Section 7.

NAME OF DAM: BEATTIES MILLPOND DAM

As described in Section 5 of this report, the dam would be overtopped by the SDF. The maximum depth of flow over the crest would be 2.2 feet with an average critical velocity of 6.9 f.p.s. The total duration of overtopping would be 6.8 hours. Because the critical velocity would exceed the effective eroding velocity for a vegetated earth embankment of 6.0 feet per second, and the duration and depth of overtopping would be substantial, the potential overtopping flows are considered to be detrimental to the stability of the embankment.

NAME OF DAM: BEATTIES MILLPOND DAM

## SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

- 7.1 Dam Assessment: There was no engineering data available for use in preparing this report. Deficiencies discovered during the field inspection and the office analyses require remedial treatment. The dam and appurtenant structures are generally in fair condition. Maintenance is considered inadequate. A stability check of the dam is not required.

Using the Corps of Engineers' screening criteria for initial review of spillway adequacy, the 100-year flood was selected as the SDF for the "small" size - "significant" hazard classification of Beatties Millpond Dam. The spillway is capable of passing up to 8 percent of the PMF or 40 percent of the SDF without overtopping the non-overflow section of the dam. A dam failure from overtopping would not significantly increase the hazard to loss of life downstream from the dam over that which would exist just before overtopping failure. However, overtopping flows from the SDF are considered detrimental to the earth embankment. Therefore, the spillway is adjudged as inadequate but not seriously inadequate.

There is no flood warning system or emergency action plan currently in operation.

- 7.2 Recommended Remedial Measures: A formal warning system and emergency action plan should be developed and put into effect as soon as possible. Regular inspections should be made of the dam and appurtenant structures. A thorough check list should be compiled for use by the owner's representative as a guide for the inspections. Maintenance items should be completed annually. If seeps develop and flows increase or turbidity is noted, a qualified geotechnical engineering firm should be retained to perform a stability check on the dam.

The following measures should be undertaken as part of a regularly scheduled inspection and maintenance program:

- 1) Cut off all trees and brush growing on the embankment at ground level. All trees with a trunk diameter greater than 3 inches should have their root systems removed. The resultant holes should be backfilled, compacted and seeded.

NAME OF DAM: BEATTIES MILLPOND DAM

- 2) Establish a good grass cover over the entire embankment.
- 3) Place riprap on the upstream embankment to minimize erosion due to wave action.
- 4) Repair the eroded and undercut areas beneath the downstream ends of the training and wing walls of the principal spillway. The eroded and slumped areas should be backfilled, compacted and seeded.
- 5) After repairs are made to the principal spillway, examine the area at regular intervals for renewed signs of seepage.
- 6) Rebuild the concrete step in the principal spillway.
- 7) Place riprap at the pool of the spillway to prevent scouring of the pool and erosion of the areas beneath the concrete step and the wing and training walls.
- 8) Divert the flow from the natural spring in the hillside downstream from the right abutment away from the toe of the dam.
- 9) Remove the tree obstructing the approach area of the principal spillway.
- 10) Remove the trees obstructing the lower end of the discharge channel.
- 11) Install a staff gage to monitor reservoir levels above normal pool.

NAME OF DAM: BEATTIES MILLPOND DAM

APPENDIX I

PLATES

**CONTENTS**

**Location Plan**

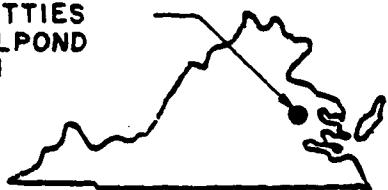
**Plate 1: Field Sketch**

**Plate 2: Top of Dam Profile**

**Plate 3: Cross Sections of Dam**

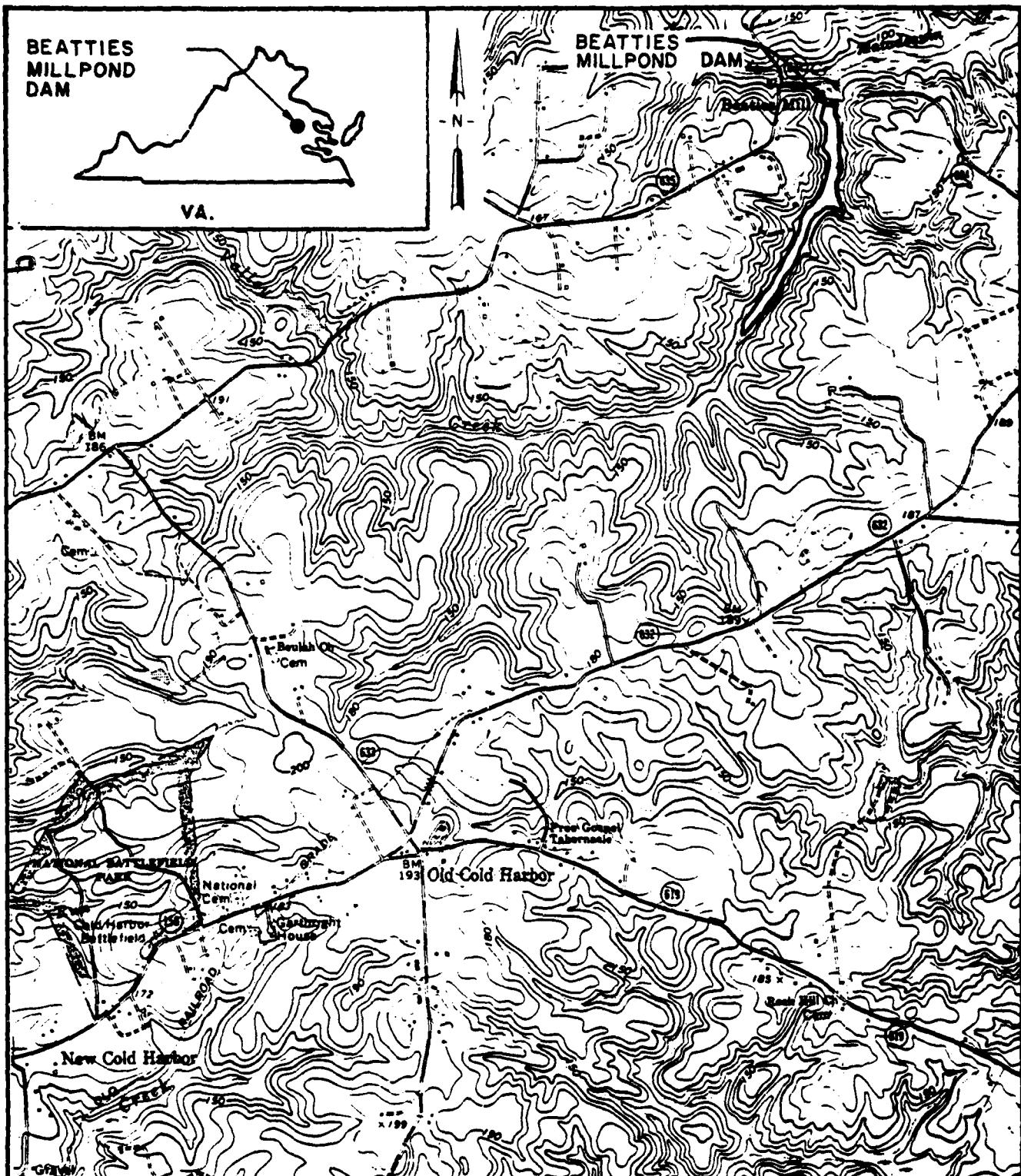
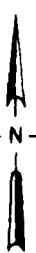
**NAME OF DAM: BEATTIES MILLPOND DAM**

BEATTIES  
MILLPOND  
DAM

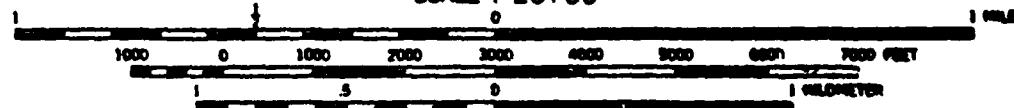


VA.

BEATTIES  
MILLPOND DAM



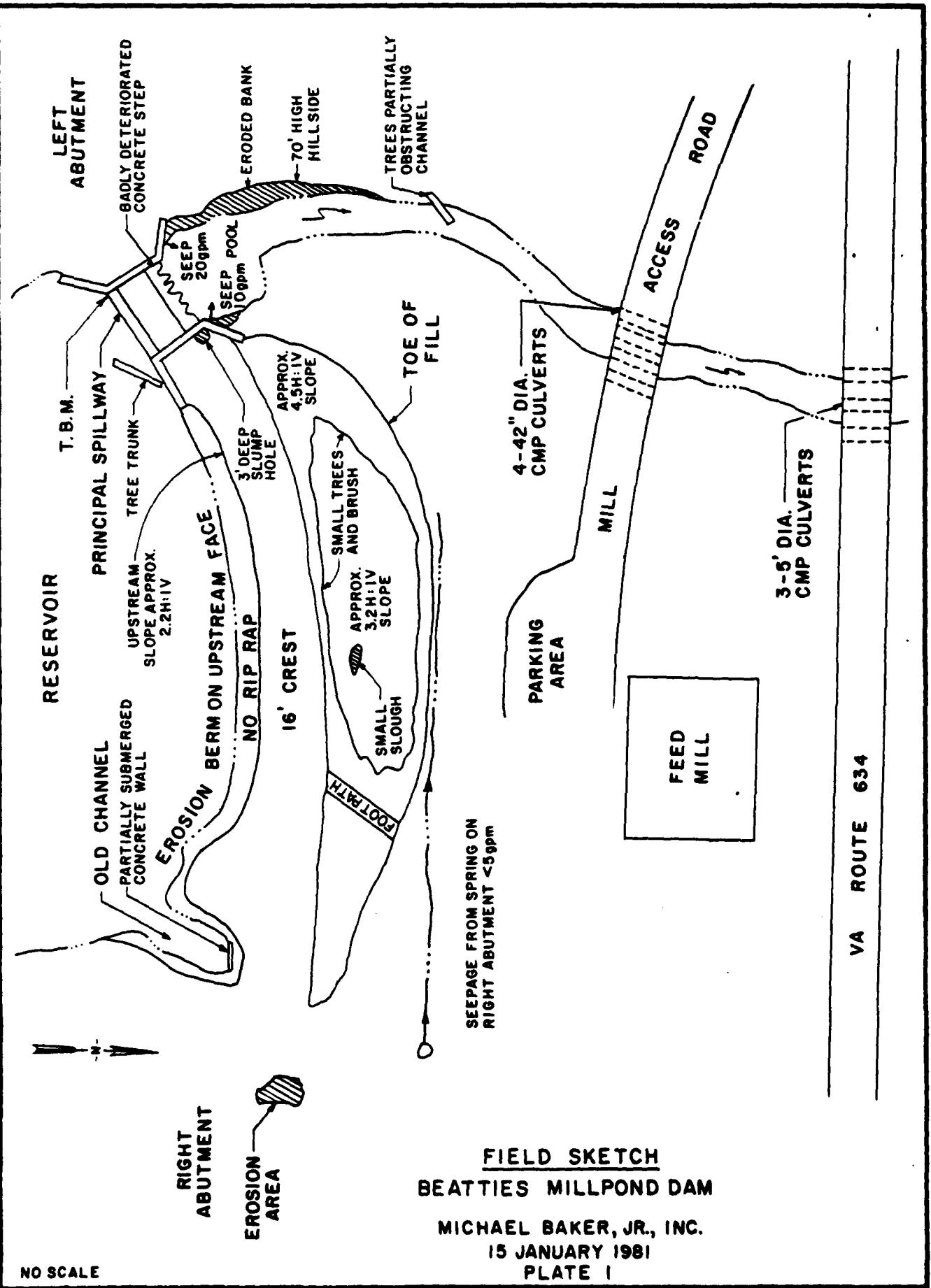
SCALE 1:26700



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QUADRANGLE. PHOTOREVISED 1968 & 1974
2. U.S.G.S. 7.5' QUINTON, VA.  
QUADRANGLE. PHOTOREVISED 1974

LOCATION PLAN  
BEATTIES MILLPOND DAM



MICHAEL BAKER, JR., INC.  
THE BAKER ENGINEERS  
Box 280  
Beaver, Pa. 15009

Subject VIRGINIA Dams S.O. No. \_\_\_\_\_  
Bethles Millpond Dam Sheet No. \_\_\_\_\_ of \_\_\_\_\_  
Top of Dam Profile Drawing No. \_\_\_\_\_  
Computed by APK Checked by \_\_\_\_\_ Date \_\_\_\_\_

TOP OF DAM PROFILE LOOKING DOWNSTREAM

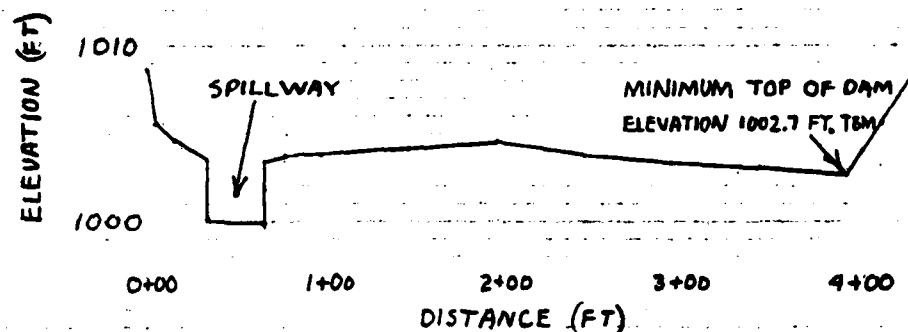


PLATE 2

MICHAEL BAKER, JR., INC.

THE BAKER ENGINEERS

Box 280  
Beaver, Pa. 15009

Subject VIRGINIA DAMS

S.O. No. \_\_\_\_\_

Beetles Mill Pond Dam

Sheet No. \_\_\_\_\_ of \_\_\_\_\_

Dam Cross-Sections

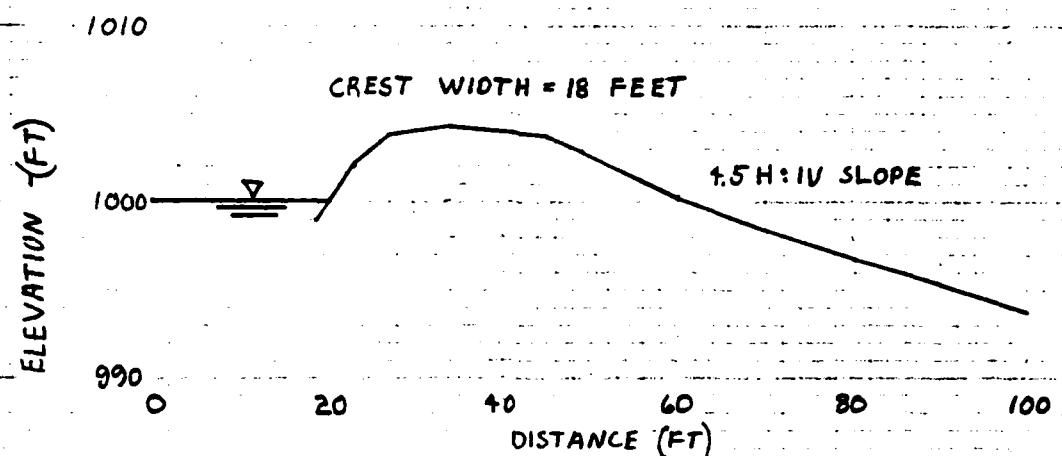
Drawing No. \_\_\_\_\_

Computed by \_\_\_\_\_

Checked by \_\_\_\_\_

Date \_\_\_\_\_

### DAM CROSS-SECTION AT STA. 1+60



### DAM CROSS-SECTION AT STA. 2+20

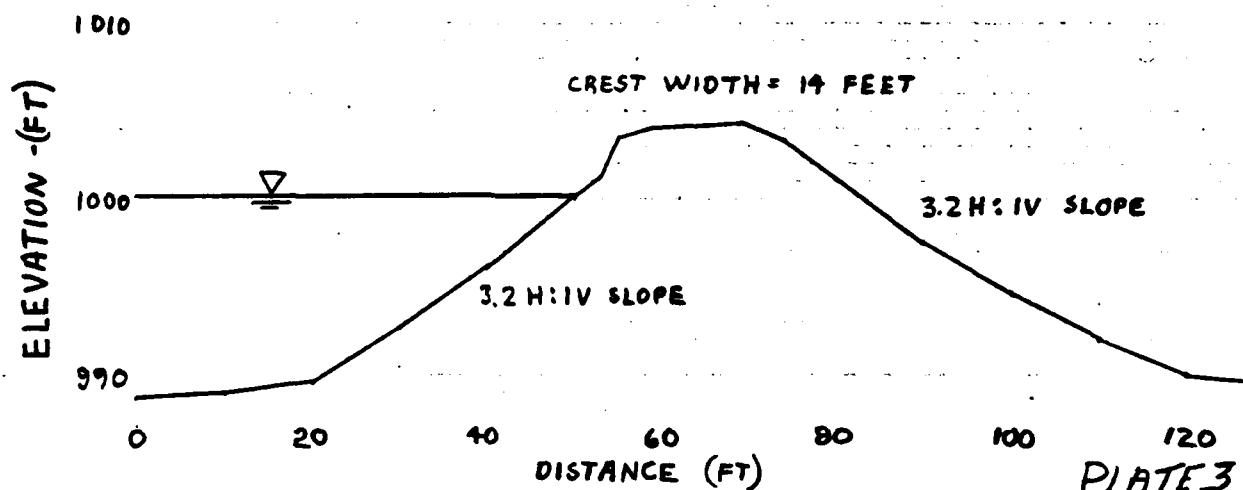


PLATE 3

**APPENDIX II**  
**PHOTOGRAPHS**

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- Photo 1: Downstream Embankment of Dam
- Photo 2: Upstream Embankment of Dam
- Photo 3: View of Principal Spillway from VA Route 634
- Photo 4: Left Side of Downstream Principal Spillway Showing Undercutting of Training Wall
- Photo 5: Hole Behind Right Training Wall
- Photo 6: Right Abutment Area Showing Location of Former Raceway for Mill

Note: Photographs were taken on 15 January 1981.

NAME OF DAM: BEATTIES MILLPOND DAM

**BEATTIES MILLPOND DAM**



**PHOTO 1. Downstream Embankment of Dam**



**PHOTO 2. Upstream Embankment of Dam**

**BEATTIES MILLPOND DAM**



**PHOTO 3. View of Principal Spillway from VA Route 634**



**PHOTO 4. Left Side of Downstream Principal Spillway Showing Undercutting of Training Wall**

**BEATTIES MILLPOND DAM**



**PHOTO 5. Hole Behind Right Training Wall**



**PHOTO 6. Right Abutment Area Showing Location of Former  
Raceway for Mill**

**APPENDIX III**  
**VISUAL INSPECTION CHECK LIST**

Check List  
Visual Inspection  
Phase 1

Name of Dam Beatties Millpond Dam County Hanover State Virginia Coordinates Lat. 3737.3

Long. 7115.0

Date of Inspection 15 January 1981 Weather Cold, cloudy, snow Temperature 30° F.

Pool Elevation at Time of Inspection 1000.1 ft. T.B.M.\* Tailwater at Time of Inspection 989.3 ft. T.B.M.\*

\*All elevations are referenced to a Temporary Bench Mark (T.B.M.) with an assumed elevation of 1000.0 ft. The T.B.M. was located on the left side of the spillway crest.

III-1

Inspection Personnel:

Michael Baker, Jr., Inc.

Owner's Representatives:

Stephen Shoemaker  
Anthony Klimek  
David Meredith

Mr. David Beattie  
Mrs. John Beattie  
Mr. Cooley

Virginia State Water Control Board:

Leon Musselwhite

Stephen Shoemaker \_\_\_\_\_ Recorder

Name of Dam: BEATTIES MILLPOND DAM

EMBANKMENT

| VISUAL EXAMINATION OF                             | OBSERVATIONS   | REMARKS OR RECOMMENDATIONS  |
|---|--|---|
| SURFACE CRACKS                                    | None observed  |   |
| UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE | None observed. Small mounds were observed at the toe near the center of the dam. They appear to have been the result of grading of the mill parking lot. | Riprap should be placed on the upstream face of the dam due to wave action. There are weeds and small brush growing on the upstream face. The downstream face is somewhat obscured by weeds and small trees (less than 6 in. diameter). There is a small slough in the right center of the dam which is apparently stabilized by vegetation. A concrete wall and old channel exist at the right abutment. This channel is filled in downstream from the crest of the dam and appears to have been the old raceway for the mill. |

Name of Dam BEATTIES MILLPOND DAM

EMBANKMENT

VISUAL EXAMINATION OF OBSERVATIONS

VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST

The dam has a downstream curvature. The crest of the dam varies vertically about 1.5 ft. with the lowest area near the right abutment. No significant horizontal misalignment was observed. The grass covered crest is about 16 ft. wide.

RIPRAP FAILURES

There is no riprap on the dam.

VEGETATION

The downstream embankment is covered with small trees and brush. The majority of the crest is grass covered although a foot path running along the crest contains several areas of sparse vegetation. Brush and weeds are growing on the upstream face of the crest near the water surface.

All trees on the downstream slope should be cut off at ground level. All trees with a trunk diameter greater than 3 in. should have their root systems removed. The resultant holes should be backfilled, compacted and seeded. A good grass cover should be established over the entire embankment.

Name of Dam BEATTIES MILLPOND DAM

EMBANKMENT

| VISUAL EXAMINATION OF                                 | OBSERVATIONS   | REMARKS OR RECOMMENDATIONS  |
|---|--|---|
| JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM | A concrete spillway is located on the left abutment. The areas beside and beneath the downstream end of the training and wing walls have been undercut and eroded, leaving the walls with very little support. The right abutment contains a partially filled channel that appears to have been the old mill raceway. The area adjacent to the right abutment is a wooded hillside which has been slightly eroded.   | Repairs should be made beneath the downstream end of the training and wing walls and riprap placed in the area to prevent erosion in the future. The eroded areas behind the walls should be backfilled, compacted, and seeded. The erosion on the hillside on the right abutment does not affect the stability of the dam.                                       |
| ANY NOTICEABLE SEEPAGE                                | Clear seepage is emanating from the base of both training walls of the spillway. Seepage along the right training wall has washed soil away, creating a 3 ft. deep slump hole on the crest behind the wall. The seepage along the left and right wall is estimated to be 20 g.p.m. and 10 g.p.m., respectively. There is also seepage from a natural spring in the hillside downstream from the right abutment. This seepage flows along the toe of the dam. | Rebuild the foundations under the wing and training walls as described above. Backfill, compact, and seed the eroded and slumped areas. This area should be inspected on a regular basis to monitor signs of renewed seepage. The seepage from the hillside downstream from the right abutment should be redirected toward the downstream area away from the toe. |

Name of Dam: BEATTIES MILL POND DAM

EMBANKMENT

| VISUAL EXAMINATION OF   | OBSERVATIONS   | REMARKS OR RECOMMENDATIONS  |
|-------------------------|--|---|
| STAFF GAGE AND RECORDER | None observed.   | A staff gage should be installed to monitor reservoir levels above normal pool. |
|                         | The owner indicated that the dam was overtopped in 1939, 1959, and 1971.   |   |
| DRAINS                  | None observed  |   |
| EMBANKMENT MATERIALS    | The outer embankment materials were observed to consist of brown sandy clay of low plasticity. The ground surface of the embankment and abutments was generally dry and frozen with a light dusting of snow at the time of inspection. | The owner indicated that the embankment materials are homogeneous.              |
| OTHER                   | The owner indicated the dam was breached and rebuilt in 1959.  |   |

Name of Dam: BEATTIES MILLPOND DAM

UNGATED SPILLWAY

| VISUAL EXAMINATION OF | OBSERVATIONS   | REMARKS OR RECOMMENDATIONS  |
|-----------------------|--|---|
| CONCRETE WEIR         | <p>The concrete spillway located on the left abutment of the dam is 32 ft. wide (measured perpendicular to the flow). There is a concrete training wall on each side of the spillway. These walls are 8 in. thick and extend 3.5 ft. above the spillway crest. The spillway is made up of two continuous concrete plates. The first plate is a broad-crested concrete weir 18 in. long (measured with the flow). After flowing over the weir, water flows down an 11.5 ft. long concrete apron which has a downstream slope of 178. There are three standing and two fallen concrete piers located on the upstream edge of the concrete apron. There is slight erosion and spalling of the spillway surface with a 1 in. deep crack in the middle which runs in the direction of flow. Concrete patches cover the construction joints between the base and the training walls.</p> | <p>The spalling and surface cracks in the spillway do not appear to be detrimental to the stability of the dam.</p> |
| APPROACH CHANNEL      | <p>There is some sediment on the approach side of the spillway. There is no actual approach channel; the reservoir is contiguous with the spillway. A tree trunk partially blocks the right side of the spillway approach area.</p>  | <p>The tree partially blocking the right side of the spillway approach area should be removed.</p>                  |

Name of Dam: BEATTIES MILLPOND DAM

UNGATED SPILLWAY

| VISUAL EXAMINATION OF | OBSERVATIONS   | REMARKS OR RECOMMENDATIONS  |
|-----------------------|--|---|
| DISCHARGE CHANNEL     | Water flows over the spillway and has an immediate drop of about 3 ft. down to a badly deteriorated and eroded concrete step which varies between 2 and 4 ft. long and runs the width of the spillway. Water flows off this concrete surface and has a near vertical drop of about 8 ft. over a hard clay surface to a pool located at the base of the spillway. Although obscured by falling water, it appears that some material has eroded from underneath the toe of the spillway. Water flows out of this pool into a 20 ft. wide discharge channel. The left side of the discharge channel is extremely eroded. This hillside is about 70 ft. high and is eroded along its entire height. The owner of the adjacent property indicated that about 10 ft. of this hillside has eroded away over the past 20 years. Trees which have broken off this bank are partially blocking the lower end of the discharge channel. | The concrete step immediately downstream from the spillway should be rebuilt. Riprap should be placed at the pool at the base of the spillway to prevent undercutting and erosion from beneath the spillway. The trees partially obstructing the lower end of the discharge channel should be removed. The erosion on the left bank of the discharge channel is not considered detrimental to the stability of the dam. |

UNGATED SPILLWAY

Name of Dam: BEATTIES MILL POND DAM

| VISUAL EXAMINATION OF | OBSERVATIONS  | REMARKS OR RECOMMENDATIONS |
|-----------------------|---|----------------------------|
| BRIDGE AND PIERS      | <p>The training walls of the spillway are structurally intact. There are five 8 in. sq. and 3 ft. high concrete piers located across the spillway. The piers are badly deteriorated and spalled at the bottom. Two of the piers have been completely deteriorated at the base, have fallen over, and are being held in place by steel rebars. Grooves in the piers indicate that the piers' original purpose was to hold wooden gates. When in place, the wooden gates would raise the water level by approximately 3 ft., thereby allowing water to discharge through a channel on the right abutment to provide water power for the mill. This channel has been filled in from the crest to the toe of the dam.</p> |                            |

INSTRUMENTATION

Name of Dam: BEATTIES MILLPOND DAM

| VISUAL EXAMINATION    | OBSERVATIONS  | REMARKS OR RECOMMENDATIONS |
|-----------------------|---------------|----------------------------|
| MONUMENTATION/SURVEYS | None observed |                            |
| OBSERVATION WELLS     | None observed |                            |
| WEIRS                 | None observed |                            |
| PIEZOMETERS           | None observed |                            |
| OTHER                 |               |                            |

| RESERVOIR             |                              |  |                            |
|-----------------------|------------------------------|--|----------------------------|
| Name of Dam:          | <u>BEATTIES MILLPOND DAM</u> |  |                            |
| VISUAL EXAMINATION OF |                              | OBSERVATIONS   | REMARKS OR RECOMMENDATIONS |
| SLOPES                |                              | The banks of the reservoir are moderately sloping and wooded. A few houses and cabins line the reservoir. They are located about 15 to 20 ft. above the normal pool.   |                            |
| SEDIMENTATION         |                              | There is considerable sediment in the approach area to the spillway. The extent of sedimentation in the reservoir was not directly observed; however, it is not expected to be significant. The depth of the reservoir was determined to be 11.4 ft. at 50 ft. from shore. |                            |

Name of Dam: BEATTIES MILLPOND DAM

DOWNSTREAM CHANNEL

| VISUAL EXAMINATION OF<br>CONDITION<br>(OBSTRUCTIONS,<br>DEBRIS, ETC.) | OBSERVATIONS   | REMARKS OR RECOMMENDATIONS  |
|---|--|---|
|   | <p>A feed mill located in the downstream channel area has a raised access road which crosses the downstream channel. The channel crosses the road through four 42 in. diameter C.M.P. culverts. VA Route 634 is located about 300 ft. downstream and its embankment obstructs the channel across its entire width. The crest of VA Route 634 is about 1 ft. higher than the crest of the spillway. Three 5 ft. diameter C.M.P. culverts carry the flow underneath VA Route 634. The channel enters the Matapequin Creek about 500 ft. below the dam. The banks of the downstream channel contain thick brush and trees. The next reservoir is located about 4025 ft. downstream.</p> |   |
| SLOPES  | <p>The downstream channel has a generally flat gradient with moderately sloping wooded sides.</p>  | <p>APPROXIMATE NO.<br/>OF HOMES AND<br/>POPULATION<br/>VA Route 634 is about 300 ft. downstream of the dam.</p> |

**APPENDIX IV**  
**GENERAL REFERENCES**

## GENERAL REFERENCES

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NAME OF DAM: BEATTIES MILLPOND DAM

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NAME OF DAM: BEATTIES MILLPOND DAM